PORTABLE GAMMA CAMERA

TECHNICAL FIELD

This invention relates to a portable gamma camera, in particular of the fully integrated type, that is to say, designed to operate without any cable for external connection with other apparatuses.

The main field of use of the device is oriented towards medico-diagnostic applications.

BACKGROUND ART

It is known that in the medical diagnostic applications there is frequently a need for portable instruments which are easy to handle, in such a way as to allow a direct use of the instrument (detector) on the patient and a display of the images with dedicated units positioned close to the detector. These type of detectors are characterised by a limited measuring area and a relatively light weight.

This type of application finds a technical justification linked to the fact that the overall weight of the detector may only be reduced by reducing the measuring area and consequently the use of portable detectors may find a valid use, for example, in operating rooms and in radioguided surgery, as well as in the diagnosis of small organs. The separation between detector and control/display unit is often necessary to reduce the weight of the entire detector, since otherwise it would not be easy to handle in use.

Typically, the weight of these detectors is due mainly to the materials for shielding against external radiation (shielding of the scintillation structure and collimator) which must not reach the measuring surface and typically the weight is about 1-2 kg for the most advanced detectors, having a small measuring area (5 cm×5 cm). Clearly, the component linked to the use of the electronic equipment also affects the final dimensions and, consequently, the actual possibility of making the detector made in this way easy to handle.

Therefore, the above-mentioned portable detectors prevent the display of the images directly on the same structure handled by the operator. A small device, having a small area and which can be easily handled, may be positioned directly on the organ in question, which is extremely difficult to achieve with a large detector. Reducing the organ-detector distance also has a considerable affect on the spatial resolution of the devices for diagnostic purposes.

In common practice, the use of large detectors sometimes allows for adjustments to the organ-detector position, to be performed only after some preliminary acquisitions and forcing the operator to make successive positionings of the detector on the area to be analysed. In practice, the need to separate the measuring units from the control and display unit, even if only limited to systems with large areas, finds a logic in the type of investigation in which the detector is much larger than the organ of the patient to be analysed whilst, on the other hand, it is extremely critical when the measuring area is small compared with the area where the detector is to be positioned to search for any diseases and which therefore needs rapid successive explorations. The advantage in the operating room appears very evident where the exploration of areas of tissue with a small detector necessarily needs preliminary measurements for the correct positioning of the measuring area on the part in question or on the organ (colon, breast, thyroid and parathyroids, etc.)

In the case of detectors with small areas, where the detector is, in any case, separated from the control and display unit, for obvious reasons of reducing the weight of the entire device,

the need to position the detector with respect to the physical area to be investigated results in the need for the operator to identify diagnostic details of the image observed on an external monitor, far from the corresponding investigation area, with the consequent need to apply inevitable approximations with respect to that which is displayed, not having an immediate correspondence between the physical area of the display and that of the detector.

A portable measuring instrument is also known, from the United States patent US2011/0208049, which has a display screen integrated in the detector itself.

However, this instrument has measuring elements (made from semiconductors, in particular CdZnTe) with very large dimensions (3 mm×3 mm) which considerably penalise the achievement of acceptable spatial resolutions.

More specifically, patent US2011/0208049 indicates a total investigation area (for the system known as "Microimager") which ranges from 3 inches×3 inches up to 5 inches×5 inches. Developing these measuring areas, the minimum number of measuring elements for the smallest device, using 3 mm×3 mm pixels, would be 625. Every element of CdZnTe is connected with a single pre-amplifier using a series of ASIC chips known as "RENA", each of which can control up to a maximum of 32 signals. In practice, at least twenty RENA chips would be required to control all the signals necessary for the operation of the gamma camera. Considering the dimensions of these chips, which are commercially produced in the updated version of 36 simultaneous signals per single chip, the volume necessary for packaging the chips and their control card appears very high and not easily suited to the desired characteristics of compactness and ease of handling. Moreover, since every pre-amplifier develops an absorption of at least 5 mW per channel, as indicated by the latest model produced, the total consumption would be equal to at least 3 W. Moreover, in order to control **32-36** signals, each RENA chip is combined with a single ADC (analogue-digital converter) with an average consumption of approximately 100 mW. Consequently, 20 RENA chips require at least as many ADCs, with a resulting average consumption of at least another 2 W. The development of the RENA-**3** cards results in an integrated card with 4 RENA chips mounted on board for simultaneously controlling 4 blocks with 4 ADCs, for a total of 144 channels. Each ADC is linked to the use of a FPGA, the average consumption of which may be estimated to be approximately 0.5 W. Consequently, the consumption linked to the use of 5 cards with 4 RENA chips on board is approximately at least 2.5 W. The total estimated for these electronics is therefore 7.5 W, without considering the other consumptions linked to other components (display, microprocessor, etc.).

In order to operate the 625 elements at least 5 complete cards of ADCs would be needed. The dimensions of the single RENA card with 4 integrated chips is approximately 20 cm×6 cm, with a thickness of at least 1-2 cm linked to the presence of components and connectors and the necessary presence of cooling fans for dissipating heat, required to reduce the temperature linked to the use of a multitude of cards which dissipate heat. In that situation, the absorption linked to the electronics for controlling the signals, without considering other consumptions, is very high (approx. 7-8 W) as well as certainly not providing small dimensions. In effect, the minimum area necessary to house the cards must be at least 20 cm×at least 6 cm, in addition to the positioning of the detector, the smallest dimension of which is approximately 7.5 cm×7.5 cm (3 inches×3 inches). For this reason, the dimensions of the outer container may not be less than 20 cm×10 cm×12-15 cm. The problems of high total absorption (approx. 8 W) and the